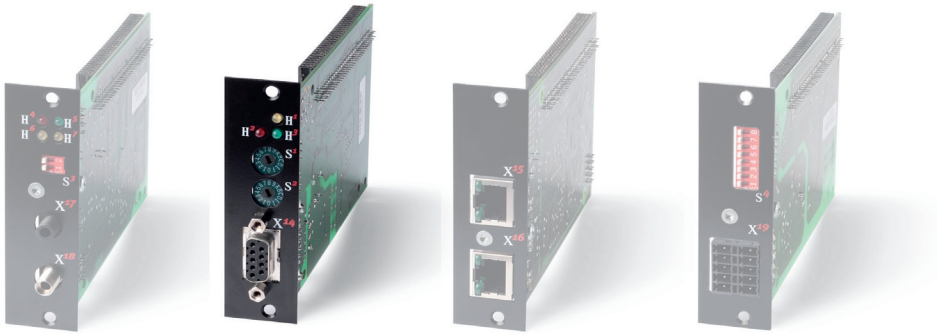
LUST

ServoOne

User manual

PROFI® PROCESS FIELD BUS BUS



SERCOS PROFIBUS EtherCAT CANopen

The bus modules for ServoOne

This manual is currently in draft prior to approval and is therefore not yet final and complete.

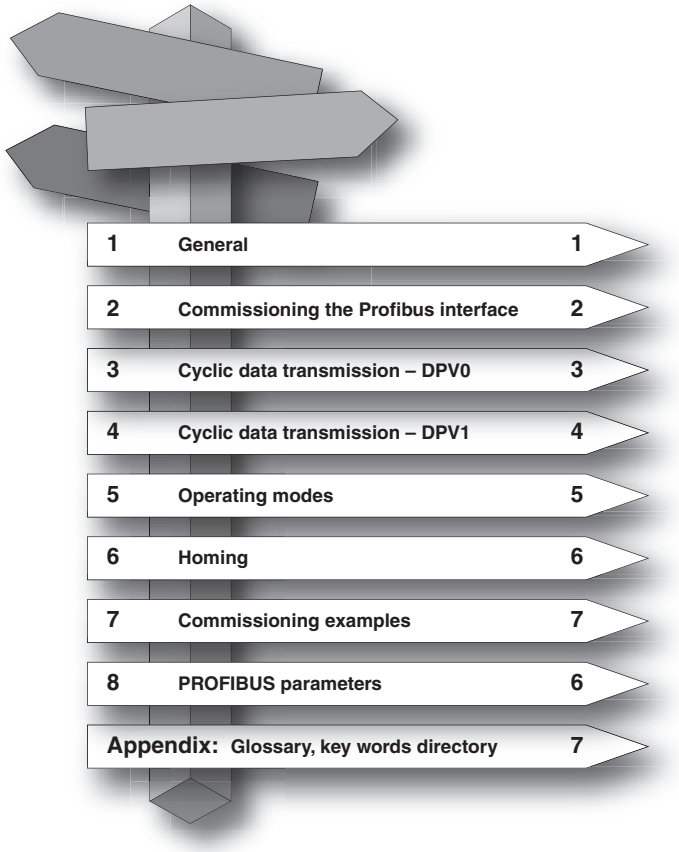
The technical data and the promised characteristics are therefore provisional and may yet change in the course of technical development!

ProfiBus ServoOne user manual

ID no.: 1100.27B.0-00
Date: 10/2007

We reserve the right to make technical changes.

How to use this manual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Dear User,

This manual is intended for use by project engineers, commissioning engineers and programmers of drives and automation solutions involving the PROFIBUS field bus.
It assumes that you have received appropriate training on Profibus and that you have access to relevant reference books. We assume that your drive has already been commissioned – if not, please first refer to the user manual.

This manual relates to the ServoOne positioning drive system, referred to below in the abbreviated form "SO".

Pictograms

	Attention! Incorrect operation may damage the drive or cause it to malfunction.
	Danger from electrical tension! Improper conduct may endanger human life.
	Danger from rotating parts! The drive may start up automatically.
	Note: Useful information

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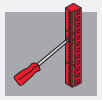
1 General

1.1 Measures for your Safety

Drive controllers of the ServoOne family are quick and easy to handle. For your own safety and for the safe functioning of your device, please be sure to observe the following points:

Read the Operating Manual first!	
	• Follow the safety instructions!
	Electric drives are subject to certain hazards: • Electric voltages > 230 V/460 V: Dangerously high voltages may still be present 10 minutes after the power is switched off. so always make sure the system is no longer live! • Rotating parts • Hot surfaces
	Your qualification: • In order to prevent personal injury or damage to property, only personnel with electrical engineering qualifications may work on the device. • Knowledge of the national accident prevention regulations (such as VBG4 in Germany) • Knowledge of structure and networking using the CAN field bus
	During installation observe the following instructions: • Always comply with the connection conditions and technical specifications. • Standards for electrical installation, e.g. cable cross-sections, screening etc. • Do not touch electronic components and contacts (electrostatic discharge may destroy components).

1.2 Introduction to PROFIBUS

The Profibus implementation in ServoOne is based on the PROFIdrive profile "Profibus PROFdrive profile version 4.0" dated August 2005.

Performance features in key words

- Data transmission using two-wire twisted pair cable (RS 485)
- Transmission rate: optionally 9.6 K, 19.2 K, 45.45 K, 93.75 K, 187.5 K, 500 K, 1.5 M, 3 M, 6 M or 12 MBaud
- Automatic Baud rate detection
- Profibus address can be set using the rotary coding switches or alternatively using the addressing parameters
- Cyclic data exchange reference and actual values using DPV0
- Acyclic data exchange using DPV1
- Synchronisation of all connected drives using freeze mode and sync mode
- Reading and writing drive parameters using the PKW channel or DPV1

1.3 System requirements

It is assumed that you have access to a standard PROFIBUS set-up program or a PROFIBUS interface driver.

1.4 Further documentation

- User manual for commissioning the drive device
- User manual for further parameterisation to customise the application.
  The user manual can be downloaded as a PDF file from the “Service” area on our Homepage http://www.lust-tec.de.
- CiA DS-301 (Rev. 4.0): Application Layer and Communication Profile
- CiA DSP-402 (Rev. 2.0): Device Profile Drives and Motion Control

2 Commissioning the Profibus interface

2.1 Connections and User controls

The connections and user controls for the Profibus interface are shown schematically in Figure 2-1. The LEDs H1, H2, H3 act as status indicators. The rotary coding switches S1 and S2 can be used to set the Profibus address for the drive. The Profibus cable is connected to the plug X14.

Front plate	No.	Comments
	H1	LED for status indication (yellow)
	H2	LED for status indication (red)
	H3	LED for status indication (green)
	S1	Rotary coding switch for setting the Profibus address for the drive = 0x(S2)(S1)
	S2	Rotary coding switch for setting the Profibus address for the drive = 0x(S2)(S1)
	X14	Profibus cable connection

Figure Profibus options card

2.2 Plug configuration for the Profibus cable

The Profibus is connected using a nine-pin sub-D plug. The pin assignment is shown in Fig. 2-2 and described in Table 2.1.

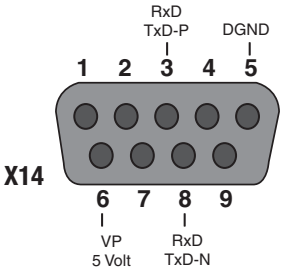


Figure Pin assignment of sub-D plug connector

PIN	RS-485	Signal	Description
1		SHIELD	Earthed shield
2		RP	Reserved for power supply via the bus
3	B/B' (red)	RxD / TxD-P	Send and receive data (+)
4		CNTR-P	Control signal for repeater (+)
5	C/C'	DGND	Data reference potential and power supply to terminating resistor (-)
6		VP	Power supply for terminating resistor (+)
7		RP	Reserved for power supply via the bus
8	A/A' (green)	RxD / TxD-N	Send and receive data (-)
9		CNTR-N	Control signal for repeater (-)

Table Description of pin assignment

The pin assignments shown with dark backgrounds in the table are not necessary from the user's point of view. The control signals used for the repeaters are optional, and the power supply for the terminating resistors is provided by the device.

2.3 Bus termination

If the drive controller is initially at the end of the bus system, a plug with an integral terminating resistor Rt should be used. In addition to the cable terminating resistor in accordance with the EIA-RS-485 standard, a pull-down resistor Rd against the data reference potential DGND and a pull-up resistor Ru against VP are provided. This ensures a defined no-load potential of 1.1 Volt between pins 3 and 8. In a made-up Profibus cable these resistors are all incorporated as standard in the Profibus plug and the terminating resistor can be activated using a switch on the Profibus plug. The following figure shows a Sub-D 9-pin plug bus termination.

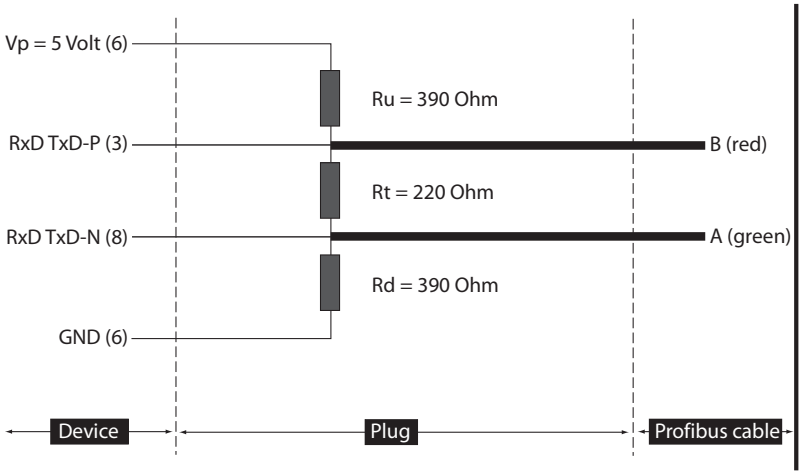


Fig. Sub-D 9-pin plug bus termination

2.4 Setting the drive address

The drive address can be set as standard using the rotary coding switches on the options card (see Fig. 2-1). The address range runs from 0 to 125. The drive address is not loaded until a 24 Volt reset has been applied to the device

The drive address can also be assigned using parameter 918 (COM_DP_Address). For this purpose the rotary coding switches must be set to value in excess of 125. The drive address set by software address is not loaded until a 24 Volt reset has been applied to the device.

2.5 Operating displays

Options module: Three LEDs are mounted on the options card; these give indications regarding the current operating status of the module. In Tables 2-2 and 2-3 the operating statuses of the Profibus module are listed, based on the various LED illumination combinations.

LED 1, green	LED 2, red	Status
		Reset (after switching on)
		ASIC RAM test and initialisation
		End of ASIC RAM test and initialisation

Table Self-test during diagnostics

LED 1, green	LED 2, red	Status
		Seeking Baud rate after switching on without bus connection
		Seeking Baud rate after the bus connection has already been established
		Awaiting parameterisation data
		Communication: Data exchange without acyclic master class 2 connection. Yellow LED lights up.

LED 1, green	LED 2, red	Status
		Communication: Data exchange “clear state”
		Incorrect parameterisation data
		Incorrect configuration data
		Communication: Data exchange with acyclic master class 2 connection.

Table Operation diagnostics

LED 3, yellow	Status
	Device is exchanging data

Table Data exchange

2.6 GSD file

The device master data file contains the summary of the device features in a standardised form. The device features include for instance the device name, the bus timing, the extended services available and the modules that can be selected (telegram types). In order to use different telegram types, the GSD file must be linked in at the configuration phase of the Profibus network. This file contains, as well as the standard “Profidrive Profile” telegrams, additional manufacturer-specific telegram types.

3 Cyclic data transmission – DPV0

3.1 Parameter process data objects (PPO)

The establishment of communications between a class 1 master and the ServoOne drive controller is essentially performed in three phases. Firstly the ServoOne is parameterised with the current bus parameters, monitoring times and drive-specific parameters (phase 1). In the configuration phase a configuration sent by the master is compared with the actual ServoOne configuration (phase 2). Once these two phases have been completed successfully, the cyclic user data traffic starts (phase 3).

The various telegram types (Parameter Process Data Objects - PPO) are prepared in the GSD file. These PPOs form the basis of the configuration phase. The project engineer knows from the GSD file how many bytes are required for the input and output data for Profibus communication between the master and the drive controller and can use this information to perform his settings in the configuration tool. As well as the standard telegrams in accordance with the "PROFIdrive – Profile", there are additional user-specific telegram types. In addition to the PZD process data channel, the user-specific telegram make partial use of a PKW parameter channel.

3.1.1 Standard "PROFIdrive" telegrams

The table below lists firstly the standard "Profidrive" telegrams that are supported by the drive controller. Table 3-1 explains the abbreviations used to assign standard telegrams to a specific process data channel. The process data channel (abbreviated to PZD) is grouped by words.

Abbreviation	Name	Number of words
STW1	Control word 1	1
STW2	Control word 2	1
ZSW1	Status word 1	1
ZSW2	Status word 2	1
NSOLL_A	Speed reference	1
NIST_A	Actual speed	1
SATZANW	Set selection (from the driving set table)	1
AKTSATZ	Current set selection (from the driving set table)	1
XSOLL_A	Reference position	2
XIST_A	Actual position	2
TARPOS_A	Reference destination position	2
VELOCITY_A	Reference speed	2

Table Abbreviations

Standard telegram 1 is a defined telegram type for speed control. It consists of two input words and two output words as shown in the following table.

PZD number	1	2
Reference values	STW1	NSOLL_A

PZD number	1	2
Actual values	ZSW1	NIST_A

Table Standard telegram 1

Standard telegram 7 is a defined telegram type for driving set selection. There are a total of 16 driving sets available for selection in the drive. This telegram type consists of two input words and two output words as shown in the following table.

PZD number	1	2
Reference values	STW1	SATZANW

PZD number	1	2
Actual values	ZSW1	AKTSATZ

Table Standard telegram 7

Standard telegram 8 is a defined telegram type for positioning with the facility for specifying a positioning speed. It consists of five input words and five output words as shown in the following table.

PZD number	1	2	3	4	5
Reference values	STW1	XSOLL_A		STW2	NSOLL_A

PZD number	1	2			
Actual values	ZSW1	XIST_A		ZSW2	NIST_A

Table Standard telegram 8

Standard telegram 9 is a defined telegram type for positioning. It consists of six input words and five output words as shown in the following table.

PZD number	1	2	3	4	5	6
Reference values	STW1	TARPOS_A		STW2	VELOCITY_A	

PZD number	1	2			
Actual values	ZSW1	XIST_A		ZSW2	NIST_A

Table Standard telegram 9

Every standard telegram in the device is described in the GSD file by a PROFIdrive Profile configuration identifier (ID). The following table shows these identifiers for the selected standard telegrams.

Telegram type	Data area	Identifier (ID)
Standard telegram 1	2 output words and 2 input words	0xC3 0xC1 0xC1 0xFD 0x00 0x01
Standard telegram 7	2 output words and 2 input words	0xC3 0xC1 0xC1 0xFD 0x00 0x07
Standard telegram 8	5 output words and 5 input words	0xC3 0xC4 0xC4 0xFD 0x00 0x08
Standard telegram 9	6 output words and 5 input words	0xC3 0xC5 0xC4 0xFD 0x00 0x09

Table Identifiers

3.1.2 User-specific PPOs

As well as the standard telegrams that are supported there are in addition further user-specific PPOs (Parameter Process data Objects). The following PPOs are also transmitted cyclically and in addition to the PZD process data channel partially contain a PKW parameter channel, thereby allowing access to the drive parameter values.

PPO	PKW				PZD									
1	PKE	IND	PKW 1	PKW 2	STW/ ZSW	REFERENCE VALUE/ ACTUAL VALUE	-	-	-	-	-	-	-	-
2	PKE	IND	PKW 1	PKW 2	STW/ ZSW	REFERENCE VALUE/ ACTUAL VALUE	PZD 3	PZD 4	PZD 5	PZD 6	-	-	-	-
3*	-	-	-	-	STW/ ZSW	REFERENCE VALUE/ ACTUAL VALUE	-	-	-	-	-	-	-	-
4	-	-	-	-	STW/ ZSW	REFERENCE VALUE/ ACTUAL VALUE	PZD 3	PZD 4	PZD 5	PZD 6	-	-	-	-
5	PKE	IND	PKW 1	PKW 2	STW/ ZSW	REFERENCE VALUE/ ACTUAL VALUE	PZD 3	PZD 4	PZD 5	PZD 6	PZD 7	PZD 8	PZD 9	PZD 10
	-	-	-	-	STW/ ZSW	REFERENCE VALUE/ ACTUAL VALUE	PZD 3	PZD 4	-	-	-	-	-	-
	PKE	IND	PKW 1	PKW 2	STW/ ZSW	REFERENCE VALUE/ ACTUAL VALUE	PZD 3	PZD 4	-	-	-	-	-	-
	-	-	-	-	STW/ ZSW	REFERENCE VALUE/ ACTUAL VALUE	PZD 3	PZD 4	PZD 5	PZD 6	PZD 7	PZD 8	-	-
	PKE	IND	PKW 1	PKW 2	STW/ ZSW	REFERENCE VALUE/ ACTUAL VALUE	PZD 3	PZD 4	PZD 5	PZD 6	PZD 7	PZD 8	-	-
	-	-	-	-	STW/ ZSW	REFERENCE VALUE/ ACTUAL VALUE	PZD 3	PZD 4	PZD 5	PZD 6	PZD 7	PZD 8	PZD 9	PZD 10

(*) PPO3 is the standard telegram 1

Table User-specific Parameter Process data Objects

In the drive parameter list there exist two signal tables, which contain all the process data that can be cyclically read and written for the Profibus communications DPV0. All possible process data signals that can be written can be found in the signal table 1284 (COM_DP_SignalList_Write) and all possible process data signals that can be read can be found in the signal table 1285 (COM_DP_SignalList_Read). The most important parameters that can be read and written are also documented in Chapter 6.

The process data signals that can be written can be configured in the signal table 915 (COM_DP_PZDSelectionWrite). The number of process data available to be written are determined by the PPO type that is selected.

The process data signals that can be read can be configured in the signal table 916 (COM_DP_PZDSelectionRead). The number of process data available to be read are also determined by the PPO type that is selected.

When using standard telegrams the process data signals in the signal tables are automatically configured by the firmware.

The user-specific drive telegram types are described by a configuration identifier (ID) in the GSD file. This describes the structure of the cyclic report data using a special identification format shown in the figure below.

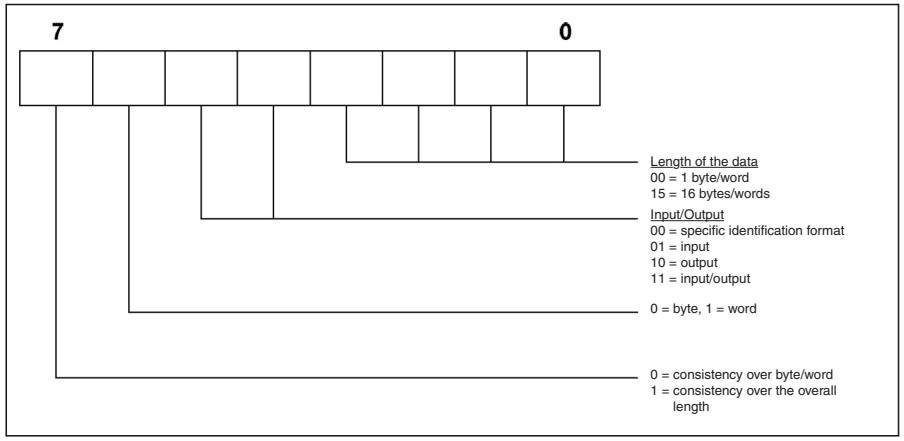


Figure Identification format (identifier)

After the parameterisation phase, the master sends the drive a configuration telegram containing this special identification (ID). On receipt of this, the drive compares the data in the configuration telegram with the configuration held in the drive. The identifier determined by the PPO type can be found in the GSD file under the heading “Modules”. The following table shows these identifiers for the user-specific telegrams.

PPO type	Identifier(ID) hex	Identifier(ID) bin	Evaluation using the special identification format (Figure 3.6)	Reference toTable AK slave-master
1	0xF3 0xF1	1111 0011 1111 0001	4 words input/output data (consistent overall length)2 words input/output data (consistent overall length)	PKW channel PZD channel
2	0xF3 0xF5	1111 0011 1111 0101	4 words input/output data (consistent overall length)6 words input/output data (consistent overall length)	PKW channel PZD channel
3	0xF1	1111 0001	2 words input/output data (consistent overall length)	PZD channel
4	0xF5	1111 0101	6 words input/output data (consistent overall length)	PZD channel
5	0xF3 0xF9	1111 0011 1111 1001	4 words input/output data (consistent overall length)10 words input/output data (consistent overall length)	PKW channel PZD channel
	0xF3	1111 0011	4 words input/output data (consistent overall length)	PZD channel
	0xF3 0xF3	1111 0011 1111 0011	4 words input/output data (consistent overall length)4 words input/output data (consistent overall length)	PKW channel PZD channel
	0xF7	1111 0111	8 words input/output data (consistent overall length)	PZD channel
	0xF3 0xF7	1111 0111 1111 0111	4 words input/output data (consistent overall length)8 words input/output data (consistent overall length)	PKW channel PZD channel
	0xF9	1111 1001	10 words input/output data (consistent overall length)	PZD channel

Table Listing of identifiers

3.1.3 PKW parameter channel

Some PPOs offer an additional cyclic parameter channel. This channel allows drive parameters to the read and written.

PKW							
1st byte	2nd byte	3rd byte	4th byte	5th byte	6th byte	7th byte	8th byte
PKE (1 word)		IND (1 word)		PKW1 (1 word)		PKW2 (1 word)	

Table Structure of the PKW channel

The parameter consists of a total of 4 words: the parameter identifier PKE (1 word), the sub-index IND (1 word) and the parameter identification word, which occupies the data area PKW1 (1 word) to PKW2 (1 word). The parameter identification is shown by bits in the following table.

AK				PNU											
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

AK	Request or reply identification (value range 0..15)
PNU	Parameter number (value range 1…4095)

Table PKE parameter identification

The following tables list the request identification (master) and the reply identification (slave).

Request identification	Function
0	No request
1	Request parameter value
2	Change parameter value (word)
3	Change parameter value (double word)
4	Read parameter description
5	-
6	Request parameter value (array)
7	Change parameter value (array) (word)
8	Change parameter value (array) (double word)

Table Request identification AK (master ⇨ slave)

Reply identification	Function
0	No reply
1	Parameter value sent (word)
2	Parameter value sent (double word)
3	Parameter description sent
4	Parameter value (array) sent (word)
5	Parameter value (array) sent (double word)
6	–
7	Request not executable, see error no.

Table Reply identification AK (slave ⇨ master)

On reply recognition 7 the error number sent to the drive from the master is shown in the area PKW1 to PKW2. The following table lists these error numbers.

Error no.	Statement
0	Impermissible PNU
1	Parameter cannot be changed
2	Lower or upper parameter value limit transgressed
3	Defective sub-index
4	Not an array
5	Incorrect data type
...	
17	Request cannot be executed because of the operating status
18	Other error

Table Error numbers

In addition request identification 4 can be used to read a parameter description. The parameter description receives relevant information regarding the respective parameter. The following table shows the sub-indexes that can be used to access the individual parameter structure elements. The sub-index is indicated only by byte 3.

Sub-index	Meaning	Data type
1	Identifier (ID)	V2
2	Number of field elements or string length	Unsigned 16
3	Standardisation factor	Floating point
4	Variable attributes	Octet string 2
5	Reserved	Octet string 4
6	Name (only the first four bytes are sent)	Visible string 16
7	Lower limit value	Octet string 4
8	Upper limit value	Octet string 4
9	Reserved	Octet string 2
10	ID extension	Extension V2
11	PZD reference parameter	Unsigned 16
12	PZD standardisation	V2

Table Parameter description

The identifier (sub-index 1) in the parameter description identifies additional characteristics of the respective parameter. Table 3-8 describes the meaning of the identifier.

Bit	Meaning	Explanation
15	Reserved	
14	Array	
13	Parameter value can only be reset	If this bit is set, the respective parameter value can be varied externally only so as to be set to zero
12	Parameter value was changed to a value different from the factory settings	If this bit is set, the parameter value is different from the factory settings
11	Reserved	
10	Additional text array can be called up	
9	Parameter cannot be written	
8	Standardisation factor and variable attributes not relevant	This bit is set if the parameter is of a data type that cannot be used to calculate any physical values (e.g. data type string)
0 - 7	Data type of the parameter value (value = “Profi-Drive table 9”)	

Table Structure of the identifier

3.2 Master control word

	Operating mode: Speed Control	Operating mode: Positioning control
Bit 15 (MSB)	Not used	
Bit 14	Not used	
Bit 13		
0	Not used	New reference values activated by toggling the master control word bit 6a
1	Not used	New reference values are loaded directly

	Operating mode: Speed Control	Operating mode: Positioning control
Bit 12		
0	Not used	Positioning reference value = absolute
1	Not used	Positioning reference value = relative
Bit 11		
0	Not used	Stop homing run
1	Not used	Start homing run
Bit 10		
0	No access rights over the PLC	
1	Access rights over the PLC	
Bit 9		
0	Not used	
1	Not used	
Bit 8		
0	Not used	
1	Not used	
Bit 7		
0	Error acknowledgement at rising flank 0 ⇨ 1	
1		
Bit 6		
0	Deactivate reference value	Activate positioning set at rising and falling flank (0 ⇨ 1 and 1 ⇨ 0)
1	Activate reference value	
Bit 5		
0	Freeze ramp generator	No feed hold
1	Unfreeze ramp generator	Feed hold

	Operating mode: Speed Control	Operating mode: Positioning control
Bit 4		
0	Reset ramp generator	Interrupt positioning set
1	Activate ramp generator	Do not interrupt positioning set
Bit 3		
0	Controller not enabled	
1	Controller enabled (operation enabled)	
Bit 2		
0	Quick stop active	
1	Quick stop inactive	
Bit 1		
0	Spin out of true active	
1	Spin out of true inactive	
Bit 0		
0	Switch off power stage (OFF)	
1	Switch on power stage (ON)	

Table Master control word

	Meaning
Bit 0 - 11	Not used
Bit 12 - 15	Master sign of life

Table Master control word 2

If no synchronous application is implemented, the master sign of life need not be transmitted, allowing the entire second status word to be freely assigned.

3.3 Drive status word

	Operating mode: Speed Control	Operating mode: Positioning control
Bit 15 (MSB)	Not used	
Bit 14		
0	„ENPO“ or „Safe Standstill“ not set	
1	„ENPO“ or „Safe Standstill“ set	
Bit 13		
0	Drive rotating	
1	Drive stationary	
Bit 12		
0	Not used	Motion request confirmation by toggling this bit
1	Not used	
Bit 11		
0	Not used	Homing point not yet set
1	Not used	Homing point set
Bit 10		
0	Frequency or speed not reached	Target position not reached
1	Frequency or speed reached or exceeded	Target position reached
Bit 9		
0	No access rights over the PLC	
1	Access rights over the PLC granted	
Bit 8		
0	Speed error outside the tolerance band	Positioning slippage error outside the tolerance band
1	Speed error within the tolerance band	Positioning slippage error within the tolerance band
Bit 7		
0	No warning	
1	Warning registered	
Bit 6		
0	Switch on not prevented	
1	Switch on prevented	
Bit 5		
0	Quick stop activated	
1	Quick stop deactivated	
Bit 4		
0	Spin out of true activated	
1	Spin out of true deactivated	
Bit 3		
0	No error	
1	Error reported	
Bit 2		
0	Control blocked	
1	Control active (in operation / drive responding to reference values)	
Bit 1		
0	Power stage inactive (not ready)	
1	Power stage active (ready)	
Bit 0		

	Operating mode: Speed Control	Operating mode: Positioning control
0	Not ready to start	
1	Ready to start	

Table Drive status word

Bit	Meaning
0-1	Profile generator status 0: Halt 1: Acceleration 2: Positioning with allowable speed 3: Delay
2	Torque limitation with positive direction of travel
3	Torque limitation with negative direction of travel
4	ISD00
5	ISD01
6	ISD02
7	ISD03
8	Reserved
9	Reserved
10	Reserved
11	Reserved
12-15	Reserved for Profidrive

Table Master control word 2

If no synchronous application is implemented, the slave sign of life need not be transmitted, allowing the entire second status word to be freely assigned.

3.4 Drive status machine

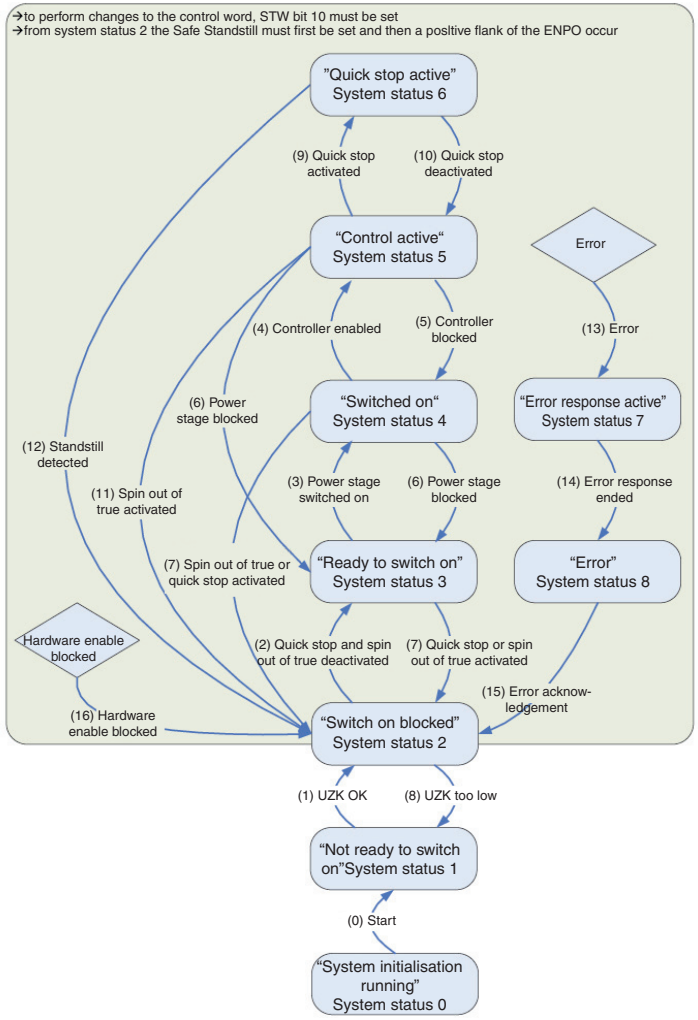

→to perform changes to the control word, STW bit 10 must be set
→from system status 2 the Safe Standstill must first be set and then a posltive flank of the ENPO occur
"Quick stop active"
System status 6
(9) Quick stop activated
(10) Quick stop deactivated
"Control active"
System status 5
Error
(4) Controller enabled
(5) Controller blocked
(13) Error
(6) Power stage blocked
"Switched on"
System status 4
"Error response active"
System status 7
(12) Standstill detected
(11) Spin out of true activated
(3) Power stage switched on
(6) Power stage blocked
(14) Error response ended
(7) Spin out of true or quick stop activated
"Ready to switch on"
System status 3
"Error"
System status 8
Hardware enable blocked
(2) Quick stop and spin out of true deactivated
(7) Quick stop or spin out of true activated
(15) Error acknow-ledgement
(16) Hardware enable blocked
"Switch on blocked"
System status 2
(1) UZK OK
(8) UZK too low
"Not ready to switch on"System status 1
(0) Start
"System initialisation running"
System status 0

Figure GeneralSystem status machine (control via Profibus)

System status	Designation	Description
0	System initialisation running (start)	Initialisation after device reset (e.g. hardware, parameter list, controller, …)
1	Not ready to switch on	Initialisation completed, but no power supply, or intermediate circuit voltage less than switch-on threshold
2	Switch-on inhibit(switch on disabled)	Intermediate circuit voltage greater than switch-on threshold
3	Ready to switch on	Optional conditions satisfied (e.g. homing run, quick stop inactive …)
4	Switched on	Power stage enabled
5	Operation enabled	Power supplied to motor, operation active
6	Quick stop active	Quick stop active*
7	Fault reaction active	Fault reaction is active, reference values from the Profibus master are ignored.
8	Fault	Drive in fault condition, reference values from the Profibus master are ignored.
* Quick stop can be triggered by various circumstances. The parameter 2218 (MP_QuickStopOC) allows the type of quick stop to be selected.		

Table System statuses

Quickstop option code	Meaning
0	Disable drive function
1	Slow down on slow down ramp
2	Slow down on quick stop ramp
3	Slow down on the current limit
4	Slow down on the voltage limit
5	Slow down on slow down ramp and stay in QUICK STOP
6	Slow down on quick stop ramp and stay in QUICK STOP
7	Slow down on the current limit and stay in QUICK STOP

Quickstop option code	Meaning
8	Slow down on the voltage limit and stay in QUICK STOP

Table Quick Stop Option Code

System status changeover	Designation	Description
0	Start	Initialisation after boot-up completed
1	UZK OK	Intermediate circuit voltage greater than switch-on threshold
2	Quick stop and spin out of true deactivated	Spin out of true deactivated ⇨ STW bit 1 = 1 Quick stop deactivated ⇨ STW bit 2 = 1
3	Power stage switched on	Power stage switched on ⇨ STW bit 0 = 1
4	Controller enabled	Controller enabled ⇨ STW bit 3 = 1
5	Control blocked	Control blocked ⇨ STW Bit 3 = 0 *
6	Power stage blocked	Power stage blocked ⇨ STW bit 0 = 0
7	Quick stop or spin out of true activated	Spin out of true activated ⇨ STW bit 1 = 0 Quick stop activated ⇨ STW bit 2 = 0
8	UZK too low	Intermediate circuit voltage less than switch-on threshold
9	Quick stop activated	Activate quick stop ⇨ STW bit 2 = 0
10	Quick stop deactivated	Deactivate quick stop ⇨ STW bit 2 = 1
11	Spin out of true activated	Activate spin out of true ⇨ STW bit 1 = 0
12	Standstill detected	Standstill was detected
13	Fault	Fault event occurred (can occur in any system status)
14	Fault reaction ended	Fault reaction has ended (e.g. fault stop ramp)
15	Fault acknowledgement	Acknowledgement of the reported fault ⇨ STW bit 7 = 1 or by a rising flank of the power stage enable

System status changeover	Designation	Description
16	Power stage blocked	Power stage blocked (can occur in any system status)
* Parameter 144 (Autostart) determines whether the control of the operation enable is flank-triggered (0) or status-dependent (1) [Parameter List ⇨Motion Profile ⇨Basic Settings].		

Table System status changeovers

4 Acyclic data transmission – DPV1

In addition to DPV0 cyclic data communications, which are intended as standard for quick updates of I/O process data, DPV1 acyclic services are available as one-off events. They offer the facility for instance to read or write parameters acyclically and thus without interfering with cyclic data traffic. Telegram type SD2 in accordance with the following table is used for the DPV1 Profibus DP extension.

SD	LE	LEr	SD	DA	SA	DSAP	SSAP	DU	FCS	ED
Start Delimiter	Length	Length repeat	Start Delimiter	Destination Address	Source Address	Destination Service Access Point	Source Service Access Point	Data Unit	Frame Check Sequence	End Delimiter
68H	X	X	68H	xx	xx	xx	xx	X..	xx	16H

Table Profibus SD2 telegram for DPV1 services

The acyclic services can be used equally well by a class 1 master (PLC etc.) and by a class 2 master (PC tool). The following table gives and overview of the acyclic services available in relation to the respective master class.

Acyclic services	Master class	Meaning	DSAP	SSAP
Initiate request	2	Establish an acyclic connection	32H	31H
Abort request	2	Break off an acyclic connection	32H	0..30H
Read request	2	Read request via DPV1	32H	0..30H
Write request	2	Write request via DPV1	32H	0..30H
Data request	2	Data transfer	32H	0..30H
Read request	1	Read request via DPV1	33	33H
Write request	1	Write request via DPV1	33	33H
Interrupt	1	Interrupt handling	33	33H
[Interrupts are not currently supported]				

Table An overview of the acyclic services offered

The access mechanism on DPV1 is always performed according to a fixed layout:

1. Write request (5F):

SD	..	DSAP	SSAP	DU Req. ID	DU Slot	DU Index	DU Length	DU User	FCS	ED
68H	xx	32	30	5F	0	2F	n+1	0..n	xx	16H

2. Write reply (5F):

SD	..	DSAP	SSAP	DU Req. ID	DU Slot	DU Index	DU Length	FCS	ED
68H	xx	32	30	5F	0	2F	n+1	xx	16H

3. Read request (5E):

SD	..	DSAP	SSAP	DU Req. ID	DU Slot	DU Index	DU Length	FCS	ED
68H	xx	32	30	5E	0	2F	MAX	xx	16H

4. Read reply (5E):

SD	..	DSAP	SSAP	DU Req. ID	DU Slot	DU Index	DU Length	DU User	FCS	ED
68H	xx	32	30	5E	0	2F	n+1	0..n	Xx	16H

Each read or write access must first be initiated by a write service on Data Unit Index 47 (2Fhex) (1). This write request gives the slave the information about the request it should execute. After this the slave acknowledges with a reply telegram (2), which initially contains no reply data. This is simply an acknowledgement of the request and contains only the mirrored DPV1 header of the request telegram. In the event of an error, a negative reply is sent. To then read the data from the slave, the master must present a read request (3). If the reply (4) to this is positive, the user data can be used by the master. In the event of an error, a negative reply is sent. Figure "DPV1 Read Request" shows the telegram sequence for a read access. This shows the slave sending a negative read reply to the first read request. This negative read reply means that the required data cannot yet be provided.
Not until the following cycle has the slave executed the request to the extent that it can send a positive read reply with the requested data.

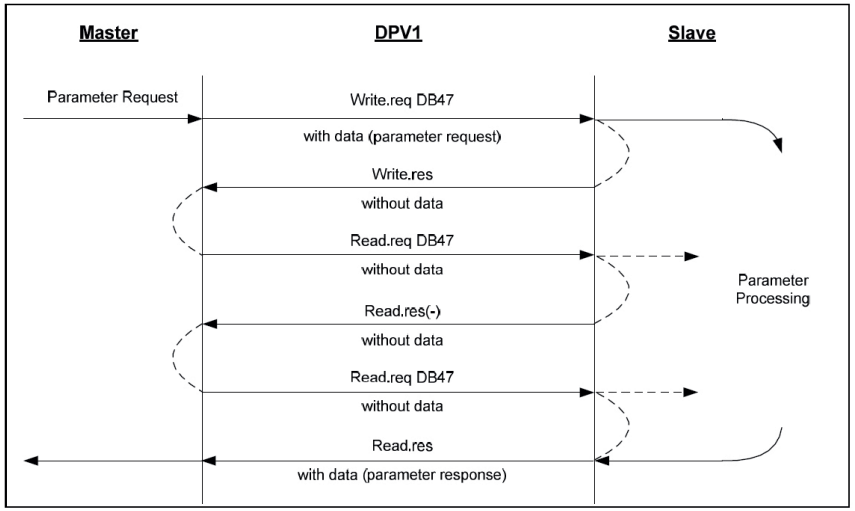


Figure DPV1 Read Request

This transmission format is in "Big Endian" (Motorola, the highest byte is transmitted first).

Word format:

0th byte	1st byte
High byte	Low byte

Double word format

0th byte	1st byte	2nd byte	3rd byte
High byte High word	Low byte High word	High byte Low word	Low byte Low word

The data unit in the table "Profibus SD2 telegram for DPV1 services" of telegram type SD2 can be split into five areas:

- Req.id (1 byte)
  This is the function number of the DPV1 service. This describes for instance whether a parameter should be read or should be written. More detailed information can be found in the table "Assignment of the Data Unit".

- Slot (1 byte)
  DPV1 slaves consist of a number of physical or virtual slots. The drive is triggered by addressing a slot, following which the slot address is not evaluated.

- Index (1 byte)
  The index contains the address of the data area in which the slave makes available the data for a parameter access. In accordance with ProfiDrive this is specified with the fixed data area number 47.

- Length (1 byte)
  Gives the length of the user data that follow. In the case of a read access, the length must be sufficiently large for the data to be read (max. 240 byte)
-
- User (1 byte…n byte)
  Contains the user data to be processed

Data Unit (DU) Byte	Data Unit Param	Value	Meaning	
0	Requ. ID	48H	Idle REQ, RES	Idle ANF, ANTW
		51H	Data transport REQ, RES	Data transport ANF, ANTW
		56H	Resource manager, REQ	Resource manager ANF
		57H	Initiate REQ, RES	Initiate ANF, ANTW
		58H	Abort REQ	Abort ANF
		5CH	Interrupt REQ, RES	Interrupt ANF, ANTW
		5EH	Read REQ, RES	Read ANF, ANTW
		5FH	Write REQ, RES	Write ANF, ANTW
		D1H	Data transport NEG RES	Data transport ANTW
		D7H	Initiate NEG RES	Initiate negative ANTW
		DCH	Interrupt NEG RES	Interrupt negative ANTW
		DEH	Read NEG RES	Read negative ANTW
		DFH	Write NEG RES	Write negative ANTW
1	Slot	00H..FEH	Slot number	

Data Unit (DU) Byte	Data Unit Param	Value	Meaning
2	Index	2FH	Index
3	Length	xx	Length of the user data (max 240 bytes)
4..n	User data	xx	User data
[Interrupts are not currently supported]			

Table Assignment of the Data Unit

In the following table the telegram format for the user data (Data Unit User Data) for a DPV1 Parameter Request and a DPV1 Parameter Reply are shown.

DPV1 Parameter Request			Byte address
Request header	Request reference	Request identification	0
	Axis No	No. of parameters (n)	2
1. Parameter address	Attribute	No. of elements	3
	Parameter Number (PNU)		
	Sub-index		
No. of parameter address	.....		4+6*(n-1)
	Format	No. of values	4+6*n
	Values		
	...		
	... ...		
			4+6*n +…+(format_n*amount_n)

Table Assignment of the Data Unit

DPV1 Parameter Reply			Byte address
Reply header	Request reference (mirror)	Response identification	0
	Axis No (mirror)	No. of parameters (n)	2
1. Parameter value	Format	No. of values	4
	Value / error code		
	...		
No. of parameter value	...	...	
			4+...+(format_n*amount_n)

Table DPV1 Parameter reply

The user data are structured as follows:

- Request reference:
  The Request Reference is specified by the master and mirrored back by the slave in the reply telegram. Based on this reference the master can uniquely assign each reply telegram to a request telegram. A master changes the request reference with each new request.

- Request ID
  This identifier has essentially the task of describing the type of parameter treatment. Currently two different identifiers are defined:
  - Requesting for a parameter
  - Changing a parameter
  Further details on identifiers can be found in the table "User data".

- Response ID
  This identifier contains information on the origin of a request. If a request is executed correctly, the response ID matches the request ID. If a request cannot be executed, an identifier in accordance with table 4.4 is generated.

- Axis No.
  This value allows an individual axis in a multi-axis system to be addressed selectively. (Axis No. ⇨ 0 single axis)

- No. of Parameters
  Number of parameters that are processed in a request

- Attributes
  Describes the individual access to a parameter structure. For instance whether one may access the actual numerical value or use the parameter description text. Further information can be found in the table "User data".

- Number of Elements
  When accessing an array or a string, this area contains the filed size or the string length

- Parameter Number
  Contains the parameter number (PNU)

- Sub-index
  Addresses the first array element of a parameter or the beginning of a character string. This also allows access to descriptive texts and text arrays.

- Format
  Specifies the respective parameter and ensures a unique assignment of the parameter value in the telegram.

- Number of values
  Number of following values

- Values
  Parameter values

Field name	Data type	Value	Meaning	Comments
Request Reference	Unsigned 8	0x00 0x01..0xFF	Reserved	
Request ID	Unsigned 8	0x00 0x01 0x02 0x03..0x03F 0x40..0x7F 0x80..0xFF	Reserved Request parameter Change parameter Reserved Manufacturer-specific Reserved	
Response ID	Unsigned 8	0x00 0x01 0x02 0x03..0x3F 0x40..0x7F 0x80 0x81 0x82 0x83..0xBF 0xC0..0xFF	Reserved Request parameter (+) Change parameter (+) Reserved Manufacturer-specific Reserved Request parameter (-) Change Parameter (-) Reserved Manufacturer-specific	
Axis No	Unsigned 8	0x00 0x01..0xFE 0xFF	Device representative Axis number 1..254 Reserved	Zero = single axis
No. of Parameters	Unsigned 8	0x00 0x01..0x27 0x28..0xFF	Reserved Quantity 1..39 Reserved	Limited by DPV1 telegram length
Attribute	Unsigned 8	0x00 0x10 0x20 0x30 0x40..0x70 0x80..0xF0	Reserved Value Description Text Reserved Manufacturer-specific	

Field name	Data type	Value	Meaning	Comments
No. of Elements	Unsigned 8	0x00 0x01..0xEA 0xEB..0xFF	Special function Quantity 1.0.234 Reserved	Limited by DPV1 telegram length
Parameter Number	Unsigned 16	0x0000 0x0001… 0xFFFF	Reserved Number 1..65535	
Sub-index	Unsigned 16	0x0000… 0xFFFF	Number 1..65535	
Format	Unsigned 8	0x00 0x01..0x36 0x37..0x3F 0x40 0x41 0x42 0x43 0x44 0x45..0xFF	Reserved Data types Reserved Zero Byte Word Double Word Error Reserved	
No. of Values	Unsigned 8	0x00..0xEA 0xEB..0xFF	Quantity 0.0.234 Reserved	Limited by DPV1 telegram length
Error Number	Unsigned 16	0x0000… 0x00FF	Error Numbers (see table below)	

Table User data

Error number	Meaning
0x00	Impermissible parameter number
0x01	Parameter value cannot be changed
0x02	Value area of the parameter transgressed
0x03	Defective parameter sub-index
0x04	Parameter is not an array
0x05	Incorrect parameter data type
0x06	Change access with value not equal to zero which is not permitted

Error number	Meaning
0x07	Change access on a descriptive element, which cannot be changed
0x09	No descriptive text available
0x11	Request cannot be performed in the present system status
0x14	Impermissible value
0x15	Reply telegram is too long
0x16	Impermissible parameter address
0x17	Illegal format
0x18	Number of parameter values is inconsistent
0x19	Request is for an non-existent axis

Table Error numbers

4.1 Examples of request and reply telegrams

Write word

Re-fer.	Req. ID	Axis	No. Pa-ram.	Attr.	No. Ele.	PNU high	PNU low	Sub high	Sub low	For-mat	No. Val-ues	Val-ue high	Val-ue low
0	2	0	1	0x10	0..1	3	0x96	0	0	0x42	1	0	7

Table ID:2 Change Parameters, Attributes 0x10: Value; PNU = 918 = 0x396, Format word=0x42

Positive reply

Refer.	Req. ID	Axis	No. Param.
0	2	0	1

Table ID:2 Change Parameters

- Parameter 918 now has the value 7

Write double word

Refer.	Req. ID	Axis	No. Pa-ram.	Attr.	No. Ele.	PNU high	PNU low
0	2	0	1	0x10	0..1	4	0xFA
Sub high	**Sub low**	**Format**	**No. Values**	**Value high**	**Value low**	**Value l high**	**Value l low**
0	0	0x43	1	1	2	3	4

Table ID:2 Change Parameters, Attributes 0x10: Value; PNU = 918 = 0x396, Format word=0x42

Positive reply

Refer.	Req. ID	Axis	No. Param.
0	2	0	1

Table ID:2 Change parameters

- Parameter 884 now has the value 16909060

Read simple parameter value

Read word

Refer.	Req. ID	Axis	No. Pa-ram.	Attr.	No. Ele.	PNU high	PNU low	Sub high	Sub low
0	1	0	1	0x10	0..1	3	0x9A	0	0

Table ID:1 Request parameters, attributes 0x10: alue; PNU = 922 = 0x39A

Positive reply:

Refer.	Req. ID	Axis	No. Pa-ram.	For-mat	No values	Value high	Value low
0	1	0	1	0x42	1	0	9

Table Format word=0x42; Parameter value = 9

Read double word

Refer.	Req. ID	Axis	No. Pa-ram.	Attr.	No. Ele.	PNU high	PNU low	Sub high	Sub low
0	1	0	1	0x10	0..1	4	0xFA	0	0

Table ID:1 Request parameters, attributes 0x10: value; PNU = 1274 = 0x4FA

Positive reply

Refer.	Req. ID	Axis	No. Pa-ram.	For-mat	No values	Value H high	Value H Low	Value l high	Value l low
0	1	0	1	0x43	1	1	2	3	4

Table Format dword=0x42; parameter value = 0x01020304 = 16909060

Defective accesses

Defective parameter numbers

Refer.	Req. ID	Axis	No. Pa-ram.	Attr.	No. Ele.	PNU high	PNU low	Sub high	Sub low
0	1	0	1	0x10	0..1	0	9	0	0

Table ID:1 Request parameters, attributes 0x10: value; PNU = 9

Negative reply

Refer.	Req. ID	Axis	No. Pa-ram.	For-mat	No values	Value high	Value low
0	0x81	0	1	0x44	1	0	0

Table Format error =0x44; parameter value = 0 = incorrect parameter number

Write parameter values array

Assign process data reference values

Refer.	Req. ID	Axis	No. Param.	Attr.	No. Ele.	PNU high	PNU low	Sub high	Sub low	Format	No. Values	Value 0 high	Value 0 low	-	Value 4 high	Value 4 low
0	2	0	1	0x10	5	3	0x93	0	0	0x42	5	3	C7		0	0

Table ID:2 Change parameters, attributes 0x10: value; PNU = 918 = 0x396, format word=0x42

- Parameter values = 0x03C7, 0x04F6, 0x04F6, 0x04F6, 0

OK reply

Refer.	Req. ID	Axis	No. Param.
0	2	0	1

- Parameter 915 now contains the entries for the parameter values.
- No standard telegram smaller than 10 is set up in the device, since then it could not be overwritten. Use remedy PPO5.

Read parameter values array

Read assigned process data reference values

Refer.	Req. ID	Axis	No. Pa-ram.	Attr.	No. Ele.	PNU high	PNU low	Sub high	Sub low
0	1	0	1	0x10	5	3	0x93	0	0

Table ID:1 Attributes : 0x10 PNU = 915=0x393

OK reply

Refer.	Req. ID	Axis	No. Pa-ram.	Format	No values	Value 0 high	Value 0 low	Value 1 high	Value 1 low	Value 2 high	Value 2 low	Value 3 high	Value 3 low	Value 4 high	Value 4 low
0	1	0	1	0x42	5	3	0xC7	4	0xF6	4	0xF6	5	0	0	0

Table ID: 1 Format: 0x42

5 Operating modes

5.1 Speed Control

In speed control mode the speed control reference value can be influenced using 3 bits in the master control word (3.2).

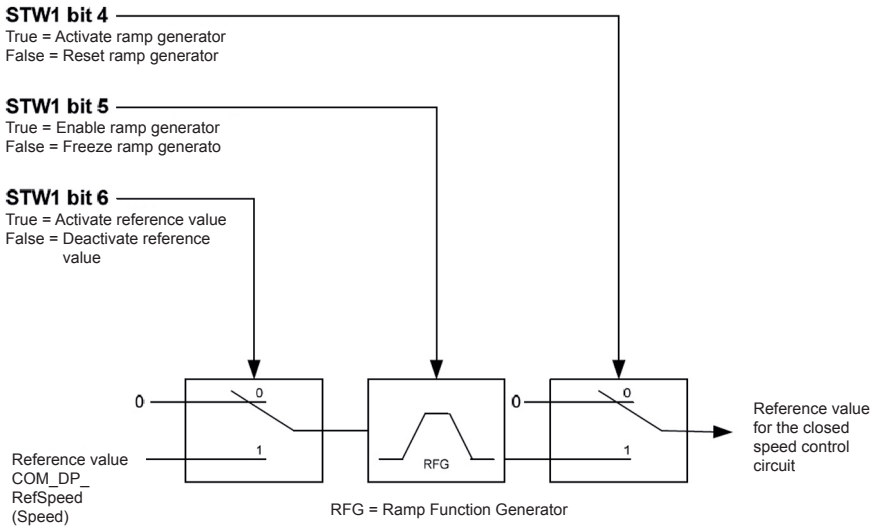
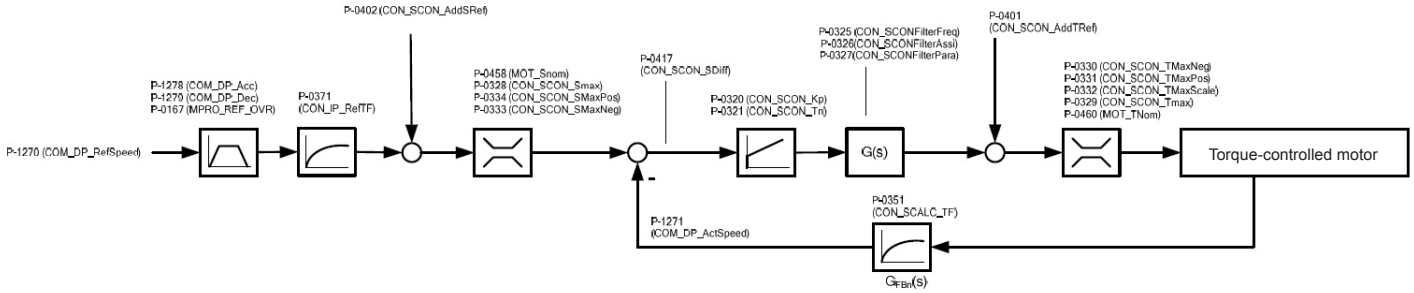


Figure Speed control

Setting the control word bit 4 allows the speed reference value to be taken over by the ramp generator. The control word bit 5 releases the ramp generator; resetting it freezes the ramp generator again.

The input of the ramp generator is influenced by the control word bit 6. If bit 6 is set, the reference value is forwarded. If bit 6 is not set, the reference value zero is forwarded.

5.2 Speed control circuit and associated control parameters



P-Nr.:	Parameter name	Meaning
P-1270	COM_DP_RefSpeed	Speed reference value
P-1278	COM_DP_Acc	Acceleration ramp
P-1279	COM_DP_Dec	Deceleration ramp
P-0167	MPRO_REF_OVR	Speed override
P-0371	CON_IP_RefTF	Filter time constant speed reference value
P-0402	CON_SCON_AddSRef	Additive speed reference value
P-0458	MOT_Snom	Nominal speed of motor
P-0328	CON_SCON_SMax	Speed limitation (reference value: nominal speed of motor)
P-0334	CON_SCON_SMaxPos	Positive speed limitation (reference value: nominal speed of motor)
P-0333	CON_SCON_ SMaxNeg	Negative speed limitation (reference value: nominal speed of motor)
P-0417	CON_SCON_SDiff	Speed controller differential
P-1271	COM_DP_ActSpeed	Actual speed
P-0320	CON_SCON_Kp	PI speed controller amplification

P-Nr.:	Parameter name	Meaning
P-0321	CON_SCON_Tn	PI_speed controller lag time
P-0325	CON_SCONFilterFreq	Limit frequencies for torque reference value filter
P-0326	CON_SCONFilterAssi	Torque reference value filter draft parameter
P-0327	CON_SCONFilterPara	Torque reference value filter parameter
P-0351	CON_SCALC_TF	Actual speed filter time constant
P-0401	CON_SCON_AddTRef	Additive torque reference value
P-0330	CON_SCON_ TMaxNeg	Negative torque limitation (reference value: nominal torque)
P-0331	CON_SCON_TMaxPos	Positive torque limitation (reference value: nominal torque)
P-0332	CON_SCON_TMax-Scale	Torque scaling factor
P-0339	CON_SCON_Tmax	Torque limitation (reference value: nominal torque)
P-0460	MOT_TNom	Motor nominal torque

Table Control parameters

5.3 Position control

In position control operating mode, based on operating status 5 (see section 3.4) the drive can change over into various statuses in response to defined bits in the master control word (3.2). These statuses are explained in Figure 5-2.

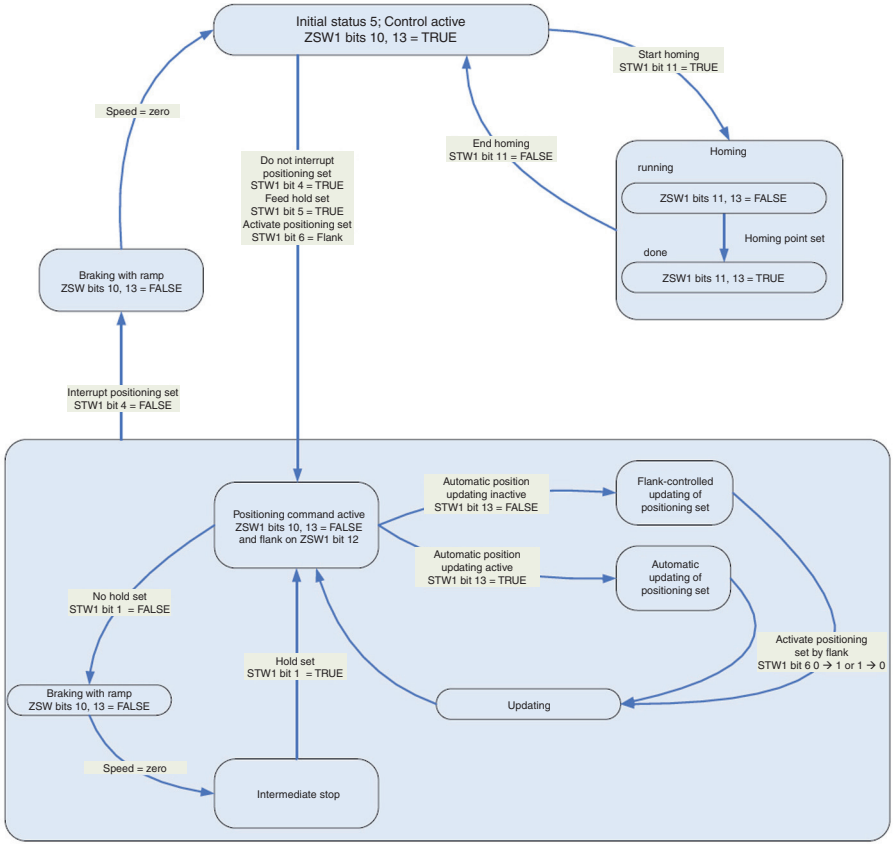

Initial status 5; Control active
ZSW1 bits 10, 13 = TRUE
Start homing
STW1 bit 11 = TRUE
Speed = zero
End homing
STW1 bit 11 = FALSE
Homing
running
ZSW1 bits 11, 13 = FALSE
Homing point set
done
ZSW1 bits 11, 13 = TRUE
Do not interrupt positioning set
STW1 bit 4 = TRUE
Feed hold set
STW1 bit 5 = TRUE
Activate positioning set
STW1 bit 6 = Flank
Braking with ramp
ZSW bits 10, 13 = FALSE
Interrupt positioning set
STW1 bit 4 = FALSE
Positioning command active
ZSW1 bits 10, 13 = FALSE
and flank on ZSW1 bit 12
Automatic position updating inactive
STW1 bit 13 = FALSE
Flank-controlled updating of positioning set
Automatic position updating active
STW1 bit 13 = TRUE
Automatic updating of positioning set
No hold set
STW1 bit 1 = FALSE
Activate positioning set by flank
STW1 bit 6 0 → 1 or 1 → 0
Hold set
STW1 bit 1 = TRUE
Braking with ramp
ZSW bits 10, 13 = FALSE
Updating
Speed = zero
Intermediate stop

Figure Position control

A positioning command is activated if the control word bit 4, the feed hold is set via bit 5 and a flank is set on control word bit 6. Further positioning commands can then be activated via the control word bit 13.

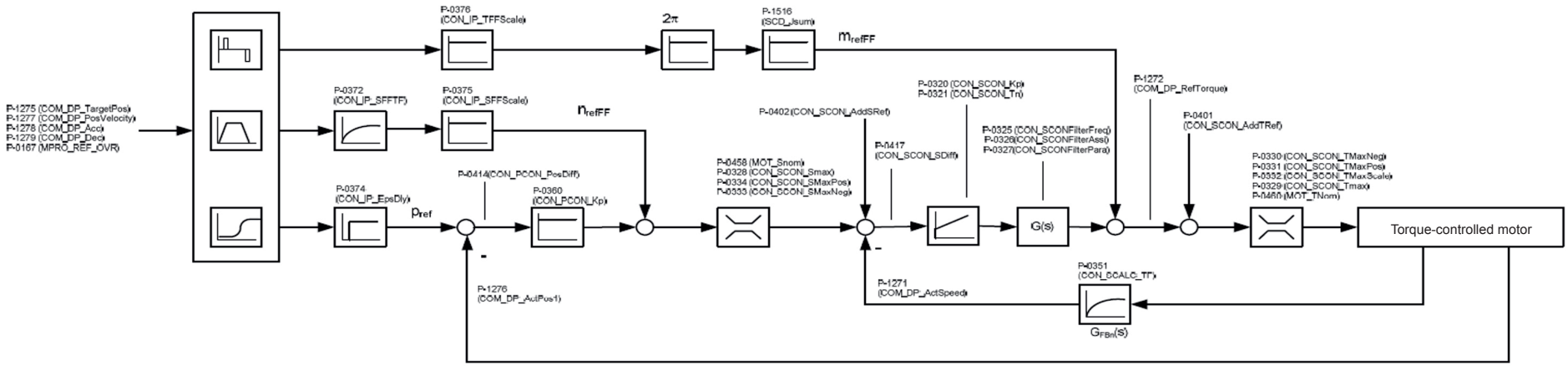
If bit 13 is set, changes to the reference position, positioning speed or positioning acceleration lead directly to a new movement request. If bit 13 is not set, a new movement request is activated only by means of a positive or negative flank of control word bit 6.

If the feed hold is reset whilst a movement command is active, the drive will be braked via a ramp to a standstill and is set to the status intermediate stop. The current movement request will not be executed until the feed hold is set again.

A movement request can be interrupted by resetting control word bit 4. In this case the drive will also be braked to a standstill and set to the status “Control active”.

In the initial status 5, additionally a homing run can be triggered by the control word bit 11.

5.4 Position control circuit and associated control parameters



P-Nr.:	Parameter name	Meaning
P-1270	COM_DP_RefSpeed	Speed reference value
P-1278	COM_DP_Acc	Acceleration ramp
P-1279	COM_DP_Dec	Deceleration ramp
P-0167	MPRO_REF_OVR	Speed override
P-1276	COM_DP_ActPos1	Current actual position
P-0402	CON_SCON_AddSRef	Additive speed reference value
P-0458	MOT_Snom	Nominal speed of motor
P-0328	CON_SCON_Smax	Speed limitation
P-0334	CON_SCON_SMaxPos	Positive speed limitation (reference value: nominal speed of motor)
P-0333	CON_SCON_ SMaxNeg	Negative speed limitation (reference value: nominal speed of motor)
P-0417	CON_SCON_SDiff	Speed controller differential
P-1271	COM_DP_ActSpeed	Actual speed
P-1516	SCD_Jsum	Overall moment of inertia
P-0376	CON_IP_TFFScale	Scaling for pre-control of acceleration
P-1275	COM_DP_TargetPos	Target position
P-1277	COM_DP_PosVelocity	Positioning speed
P-0374	CON_IP_EpsDly	Position reference delay
P-0320	CON_SCON_Kp	PI speed controller amplification
P-0321	CON_SCON_Tn	PI_speed controller lag time
P-0325	CON_SCONFilterFreq	Limit frequencies for torque reference value filter
P-0326	CON_SCONFilterAssi	Torque reference value filter parameter
P-0327	CON_SCONFilterPara	Torque reference value filter parameter
P-0351	CON_SCALC_TF	Actual speed filter time constant
P-0401	CON_SCON_AddTRef	Additive torque reference value
P-0330	CON_SCON_ TMaxNeg	Negative torque limitation (reference value: nominal torque)
P-0331	CON_SCON_TMaxPos	Positive torque limitation (reference value: nominal torque)
P-0332	CON_SCON_TMax-Scale	Torque scaling factor
P-0339	CON_SCON_Tmax	Torque limitation (reference value: nominal torque)
P-0460	MOT_TNom	Motor nominal torque
P-0372	CON_IP_SFFTF	Filter time constant speed pre-control
P-0375	CON_IP_SFFScale	Scaling for pre-control of speed
P-0414	CON_PCON_PosDiff	Position controller differential (tracking error)
P-0360	CON_PCON_Kp	Position controller amplification

Table Control parameters

6 Homing

6.1 Homing runs performed by the drive

Since relative sensor systems are used, the drive must be homed, triggered by bit 11 in control word 1. As soon as this bit is set by the master, the drive performs a position-controlled homing run using an internal profile generator and determined by homing run speed, homing run acceleration and employing the strategy saved in the homing run method.

6.2 Homing run speed

The homing run speed is specified by parameter 2262 (MPRO_402_HomingSpeeds) in the parameter editor [Parameter list⇨Motion Profile⇨Homing]. The user has the facility here to specify two different homing run speeds.

1. SpeedSwitch = Speed when moving to the limit switch
2. SpeedZero = Speed when moving to the zero point

6.3 Homing run acceleration

The homing run acceleration is specified by parameter 2263 (MPRO_402_HomingAcc) in the parameter editor [Parameter list⇨Motion Profile⇨Homing].

6.4 Zeroing offset

Absolute encoders (such as SSI multiturn encoders) present a special case for the homing run, since they directly generate the absolute position reference. For homing using these encoders it follows that no movement is required and in some circumstances even no power to the drive. Furthermore, the zeroing offset must be determined. The type 5 is particularly suitable for this. A zeroing offset can be set using the parameter 525 (ENC_HomingOff) [Parameter list⇨Motion Profile⇨Homing].

6.5 Homing cams, limit switches

The signal for the homing cams can optionally be linked to one of the digital inputs, for which the inputs ISD00 to ISD06 are available. Furthermore the limit switches can also be used for homing. The assignment of the digital inputs can be found under the parameter 101 to 107 [Parameter list⇨I/O configuration⇨Digital inputs]. When homing to the limit switches, the digital input must be selected as a positive limit switch using selection parameter LCW(5) or a negative limit switch using selection parameter LCW(6). When homing to cams, the parameter HOMSW(10) must be selected.

The following table shows the necessary assignment of the digital inputs for the respective homing run methods.

MPRO_402_ Homing Method (Parameter no. 2261)	MPRO_INPUT_ FSISDxx(Parameter no. 101-107)	Meaning
-5	-	Homing (absolute value sensor)
-4	HOMSW	Running homing, negative homing cam
-3	HOMSW	Running homing, positive homing cam
-2	-	No homing run
-1	-	Actual position = zero
0	-	Off
1, zero impulse	LCCW	Homing run negative limit switch
2, zero impulse	LCW	Homing run positive limit switch
3, zero impulse	HOMSW	Homing run to cams, negative flank,positive direction of travel

MPRO_402_ Homing Method (Parameter no. 2261)	MPRO_INPUT_ FSISDxx(Parameter no. 101-107)	Meaning
4, zero impulse	HOMSW	Homing run to cams, positive flank,positive direction of travel
5, zero impulse	HOMSW	Homing run to cams, negative flank,negative direction of travel
6, zero impulse	HOMSW	Homing run to cams, positive flank,negative direction of travel
7..14 zero impulse	HOMSW	Various homing runs to cams
15, 16	-	Reserved
17	LCCW	Homing run negative limit switch
18	LCW	Homing run positive limit switch
19	HOMSW	Homing run to cams, negative flank,positive direction of travel
20	HOMSW	Homing run to cams, positive flank,positive direction of travel
21	HOMSW	Homing run to cams, negative flank,negative direction of travel
22	HOMSW	Homing run to cams, positive flank,negative direction of travel
23..30	HOMSW	Various homing runs to cams
31, 32	-	Reserved
33	-	Zero impulse in negative direction of travel
34	-	Zero impulse in positive direction of travel
35	-	The instantaneous position is the zero position

Table Assignment of a digital output based on the homing run method

6.6 Homing movement methods

The type of homing run is selected by the parameter 2261 (MPRO_402_HomingMethod) [Parameter list ⇨Motion Profile ⇨Homing].

Further information can be found in the ServoOne user manual chapter 4.2.

7 Examples of commissioning using manufacturer-specific telegrams

7.1 Position control using PPO 5

The following section describes how the drive can be simply and quickly commissioning in the position control mode.

Firstly the GSD file "LUST0A33.gsd" must be linked in during the Profibus configuration phase and then the PPO type 5 selected. PPO type 5 consists of a PKW channel (8 byte) and 10 process data channels (20 byte). The process data area can be freely configured using this manufacturer-specific telegram. That means that the desired reference values and actual values can be mapped to a defined process data area. All mappable signals are listed in two signal tables, which can be accessed using the parameter editor under the folder Parameter list ⇨ Fieldbus ⇨ Profibus-DP in the left tree structure of the operating tool. Within this folder directory, the signal list 1284 (COM_DP_SignalList_Write) contains all possible process data signals that can be written, and the signal list 1285 (DP_SignalList_Read) contains all possible process data signals that can be read.

The user can assign the process data channels freely as required. The actual assignment can be found in the signal tables 915 and 916 [Parameter list ⇨ Fieldbus ⇨ Profibus-DP]. Signal table 915 (COM_DP_PZDSelectionWrite) contains all signals that can be sent by the control master to the drive. Signal table 916 (COM_DP_PZDSelectionRead) contains all signals that can be sent by the drive to the control master.

The following table shows an example of the process data area from the control master to the drive. For this purpose the sub-indexes in list 915 are assigned the stated parameter numbers.

Signal table 915 Sub-index	PZD area	Parameter number	Parameter name	Data type (value range)
0	1	967	Control word (COM_DP_Controlword)	U16 (0..65535)
1	2	1275	Target position (COM_DP_TargetPos)	I32 (-2147483648 ..2147483647)
2	3	1275	Target position (COM_DP_TargetPos)	
3	4	1280	Control word 2 (COM_DP_Controlword2)	U16 (0..65535)
4	5	1277	Positioning velocity (COM_DP_PosVelocity)	I32(-2147483648 ..2147483647)
5	6	1277	Positioning velocity (COM_DP_PosVelocity)	
6	7	1278	Acceleration (COM_DP_Acc)	U16 (0..65535)
7	8	1279	Braking deceleration (COM_DP_Dec)	U16 (0..65535)
8	9	0	-	-
9	10	0	-	-

Table Example of assignment of the master-slave process data channel

Each sub-index represents a 16-bit wide process data channel. For this reason for instance the target position that is sent as Int32 is mapped to sub-indices 1 and 2 in order to transmit a real 32 bits. The parameters available for selection and their data types are listed in chapter 6.

The configuration of the process data channels can be freely selected by the user in the sequence of the signal assignments. However the data type format must be complied with.

The following table shows an example of the process data area from the drive to the master. For this purpose the sub-indexes in list 916 are assigned the desired parameter numbers.

Signal table 915 Sub-index	PZD area	Parameter number	Parameter name	Data type (value range)
0	1	968	Status word (COM_DP_Statuswort)	U16 (0..65535)
1	2	1276	Actual position (COM_DP_ActPos1)	I32 (-2147483648 ..2147483647)
2	3	1276	Actual position (COM_DP_ActPos1)	
3	4	1281	Status word 2(COM_DP_Status-word2)	U16 (0..65535)
4	5	1271	Actual speed(COM_DP_ActSpeed)	I16 (-32768..32767)
5	6	-	-	-
6	7	-	-	-
7	8	-	-	-
8	9	-	-	-
9	10	-	-	-

Table Example of assignment of the slave-master process data channels

The following parameters must then be set for position control mode.

1. CON_CfgCon (300) : PCON(3) [Parameter list ⇨Motor control]
   This parameter allows the control mode to be changed. The setting PCON (Position Control Mode) means that the drive is in position control mode.
2. CON_REF_Mode (301) : RFG(0) [Parameter list⇨Motion Profile ⇨Basic settings]
   This parameter allows the mode of the position reference value to be input. The position reference value can be input directly or via a ramp generator. The setting RFG (Ramp Function Generator) means that the position reference value is input via a ramp generator.
3. MPRO_CTRL_SEL (159) : PROFIBUS(7) [Parameter List ⇨Motion Profile ⇨Basic settings]
   This parameter allows the control location to be set. In this instance the control location is selected as Profibus.
4. MPRO_REF_SEL (165) : PROFI(9) [Parameter list⇨Motion Profile⇨Basic settings]
   This parameter allows configuration of the reference value selector. In this instance the reference values are taken from the Profibus.

Once these settings have been performed, communication can be established between the master and drive.

7.2 Conversion of reference values and actual values using factor group parameters

Conversion of reference values and actual values using factor group parameters

In positioning applications the inputting of reference values and the return of actual values are generally performed using application-specific user units (mm, degrees, …). The reference values and actual values of the drive are converted using what are called factor group parameters [Parameter list⇨Motion profile⇨Standardisation/units]. For these the user has the facility to differentiate between 3 different groups of parameters. All 3 groups have the same task, which is to convert the user units to the fixed internal variables used by the servocontroller. The first factor group is based on the DSP402 standard. The parameters of this group are described in detail in the CANopen specification DSP402. The second factor group goes under the heading “Sercos”. The parameters of this group refer to the Sercos specification “SERCOS interface” (Version 2.4 / February 2005). The parameters of this group are also described in detail in the respective specification . The third factor group is called “user spec” and is user-specific group. Since this factor group is not described in detail elsewhere, the use of parameters of this group is illustrated by means of an example.

The user can select the factor group using the parameter “MPRO_FG_Type”.

Parameter number	Parameter name	Meaning
283	MPRO_FG_Type	Selection of the factor group (0) = STD/402 (1) = SERCOS (2) = USER

The parameters of the USER factor group are listed in the table below

Parameter number	Parameter name	Meaning	Unit
270	MPRO_FG_PosNorm	Sensor resolution	[incr/rev]
271	MPRO_FG_Num	Numerator (position)	[rev]
272	MPRO_FG_Den	Denominator (position)	[POS]
274	MPRO_FG_SpeedFac	Speed factor	[rev/(min*SPEED)]
275	MPRO_FG_AccFac	Acceleration factor	[rev/(sec*sec*ACC)]
284	MPRO_FG_PosUnit	Position unit	String
285	MPRO_FG_PosExp	Position exponent	-
286	MPRO_FG_PosScaleFac	Position factor	-
287	MPRO_FG_SpeedUnit	Speed unit	String
288	MPRO_FG_SpeedExp	Speed exponent	-
289	MPRO_FG_SpeedScaleFac	Speed factor	-
290	MPRO_FG_AccUnit	Acceleration unit	String
291	MPRO_FG_AccExp	Acceleration exponent	-
292	MPRO_FG_AccScaleFac	Acceleration factor	-
293	MPRO_FG_TorqueUnit	Torque unit	String
294	MPRO_FG_TorqueExp	Torque exponent	-
295	MPRO_FG_TorqueScaleFac	Torque factor	-

Table USER factor group

These define the internal resolution of the unit for:
Position: rev
Speed: rev/min
Acceleration: rev/(sec*sec)

The units are automatically defined by the profiles themselves according to DSP402 or Sercos. The units can be input manually in User setting.

The parameters for unit and exponent refer to the display and have no effect on the standardisation of the variables themselves.

The following three formulae describe the conversion of user units into the units used internally in positioning mode. They refer to reference position, speed and acceleration.

$$\text{Reference position}_{\text{Intern}}\ [\text{rev}] = \text{COM\_DP\_REFPos}\ [\text{user unit}] \bullet \frac{\text{MPRO\_FG\_Num}\ [\text{rev}]}{\text{MPRO\_FG\_Den}\ [\text{user unit}]}$$

The quotient of parameters MPRO_FG_Num and MPRO_FG_Den describes the ratio of user unit to motor revolutions. Furthermore is allows any gearing ratios or advance constants to be incorporated.

Positioning speed

$$\text{Positioning speed}_{\text{Intern}}\ \frac{[\text{rev}]}{[\text{min}]} = \text{COM\_DP\_REFSpeed}\ [\text{user unit}] \bullet \text{MPRO\_FG\_SpeedFac}\ \frac{[\text{rev}]}{[\text{Min} \bullet \text{User unit}]}$$

The parameter MPRO_FG_SpeedFac offers the facility to change the number of decimal points for the positioning speed or the unit of the positioning speed.

Positioning acceleration:

$$\text{Positioning acceleration}_{\text{Intern}}\ \frac{[\text{rev}]}{[\text{sec}^2]} = \text{COM\_DP\_Acc}\ [\text{user unit}] \bullet \text{MPRO\_FG\_AccFac}\ \frac{[\text{rev}]}{[\text{sec}^2 \bullet \text{user unit}]}$$

The parameter MPRO_FG_AccFac offers the facility to change the number of decimal points for the positioning acceleration or the unit of the positioning acceleration.

7.3 Examples for setting the user factor group

The positioning instructions should be input in degrees, so that 360° corresponds to one revolution of the motor (65536 increments per revolution of the motor). The speed should be input in rpm and the acceleration in rpm/sec. This gives the following values:

P00270 Sensor resolution = 65536 [incr/rev]

P00271 Position numerator = 1 [rev]

P00272 Position denominator = 360 [POS] **

P00274 Speed factor = 1 [rpm/SPEED]

P00275 Acceleration factor = 1/60 [rev /(sec*sec*ACC)] ****

P00284 Position unit (string) = “Degree”

P00287 Speed unit (string) = “rpm”

P00290 Acceleration unit (string) = “rpm/sec”

** POS = User unit for position
***SPEED = User unit for speed
****ACC = User unit for acceleration

7.4 Speed control using PPO 2

The following section describes how the drive can be simply and quickly commissioning in the speed control mode. Firstly the GSD file „LUST0A33.gsd“ must be linked in during the Profibus configuration phase and then the PPO type 2 selected.

PPO type 2 consists of a PKW channel (8 byte) and six process data channels (12 byte). The process data area can be freely configured using this manufacturer-specific telegram. That means that the desired reference values and actual values can be mapped to a defined process data area. All mappable signals are listed in two signal tables, which can be accessed using the parameter editor under the folder Parameter list ⇨ Fieldbus ⇨ Profibus-DP in the left tree structure of the operating tool. Within this folder directory, the signal list 1284 (COM_DP_SignalList_Write) contains all possible process data signals that can be written, and the signal list 1285 (DP_SignalList_Read) contains all possible process data signals that can be read.

The user can freely assign the process data area. The actual assignment can be found in the signal tables 915 and 916 (Parameter list ⇨ Fieldbus ⇨ Profibus-DP). Signal table 915 (COM_DP_PZDSelectionWrite) contains all signals that can be sent by the control master to the drive. Signal table 916 (COM_DP_PZDSelectionRead) contains all signals that can be sent by the drive to the control master.

The following table shows an example of the process data area from the control master to the drive. For this purpose the sub-indexes in list 915 are assigned the desired parameter numbers.

Signal table 915 Sub-index	PZD area	Parameter number	Parameter name	Data type (value range)
0	1	967	Control word (COM_DP_Controlword)	U16 (0..65535)
1	2	1270	Reference speed (COM_DP_RefSpeed)	I16 (-32768..32767)
2	3	1278	Acceleration (COM_DP_Acc)	U16 (0..65535)
3	4	1279	Braking deceleration (COM_DP_Dec)	U16 (0..65535)

Signal table 915 Sub-index	PZD area	Para-meter number	Parameter name	Data type (value range)
4	5	-	-	-
5	6	-	-	-
6	7	-	-	-
7	8	-	-	-
8	9	-	-	-
9	10	-	-	-

Table Assignment of the master-slave process data channels

Each sub-index represents a 16-bit wide process data channel. For this reason for instance an Int32 must be mapped to two sub-indices. The parameters available for selection and their data types are listed in section 6.3.

The configuration of the process data areas can be freely selected by the user in the sequence of the signal assignments. The only requirement is that the data type format must be complied with. That means that a 32-bit variable also requires 2 process data channels.

The following table shows an example of the process data area from the drive to the master. For this purpose the sub-indexes in list 916 are assigned the desired parameter numbers.

Signal table 915 Sub-index	PZD area	Para-meter number	Parameter name	Data type (value range)
0	1	968	Status word (COM_DP_Statuswort)	U16 (0..65535)
1	2	1271	Actual speed (COM_DP_ActSpeed)	I16 (-32768..32767)
2	3	-	-	-

Signal table 915 Sub-index	PZD area	Para-meter number	Parameter name	Data type (value range)
3	4	-	-	-
4	5	-	-	-
5	6	-	-	-
6	7	-	-	-
7	8	-	-	-
8	9	-	-	-
9	10	-	-	-

Table Assignment of the slave-master process data channels

The following parameters must then be set for speed control mode.

1. CON_CfgCon (300) : SCON(2) [Parameter list ⇨ control]
   This parameter allows the operating mode to be changed. The setting SCON (Speed Control Mode) means that the drive is in speed control mode.
2. CON_REF_Mode (301) : RFG(0) [Parameter list ⇨ Motion Profile ⇨ Basic settings]
   This parameter determines the mode of reference value input. The position reference value can be input directly or via a ramp generator. The setting RFG (Ramp Function Generator) means that the speed reference value is input via a ramp generator.
3. MPRO_CTRL_SEL (159) : PROFIBUS(7) [Parameter list ⇨ Motion Profile ⇨ Basic settings]
   This parameter allows the control location to be set. In this instance the control location is Profibus.
4. MPRO_REF_SEL (165) : PROFI(9) [Parameter list ⇨ Motion Profile ⇨ Basic settings]
   This parameter allows configuration of the reference value selector. In this instance the reference values are taken from the Profibus.

Once these settings have been performed, communication can be established between the master and drive.

7.4.1 Speed input

All factor group parameters are set to default values. The speed reference value can then be input scaled to the motor nominal speed. So a value of 16384 corresponds to a speed reference value of 100% of the motor nominal speed.

By using the control word (section 3.2) the drive can then be operated in speed control mode.

7.5 Mappable parameters

Parameter number	Parameter name	Write (1284)	Read (1285)	PZD length
967	COM_DP_Controlword	X	X	1
968	COM_DP_Statusword	-	X	1
1280	COM_DP_Controlword2	X	X	1
1281	COM_DP_Statusword2	-	X	1
1270	COM_DP_RefSpeed	X	X	1
1271	COM_DP_ActSpeed	-	X	1
121	MPRO_Input_State	-	X	1
143	MPRO_Output_State	-	X	1
1274	COM_DP_RefPos	X	X	2
1276	COM_DP_ActPos1	-	X	2
207	MPRO_TAB_ActIdx	X	X	1
1275	COM_DP_TargetPos	X	X	2
1277	COM_DP_PosVelocity	X	X	2
1278	COM_DP_Acc	X	X	1
1279	COM_DP_Dec	X	X	1
1287	COM_DP_TMaxPos	X	X	1
1288	COM_DP_TMaxNeg	X	X	1
...	...	...	...	...

Table

Further mappable parameters can be found in the signal tables 1284 (COM_DP_Signal-List_Write) and 1285 (DP_SignalList_Read) [Parameter List ⇨ Fieldbus ⇨ Profibus-DP].

8 Profibus parameters

The following table describes the Profibus parameters that are available.

Parameter name	Number	Value range	Default value	Can be changed	Data type	Meaning
COM_DP_RefSpeed	1270	-32768 – 32767	0	Yes	I16	Speed reference value, written by the Profibus
COM_DP_ActSpeed	1271	-32768 – 32767	0	No	I16	Actual speed
COM_DP_RefTorque	1272	-32768 – 32767	0	Yes	I16	Torque reference value, written by the Profibus
COM_DP_ActTorque	1273	-32768 – 32767	0	No	I16	Actual torque
COM_DP_RefPos	1274	-2147483648 – 2147483647	0	Yes	I32	Position reference value (ramp mode), written by the Profibus
COM_DP_TargetPos	1275	-2147483648 – 2147483647	0	Yes	I32	Position reference value (direct mode), written by the Profibus
COM_DP_ActPos1	1276	-2147483648 – 2147483647	0	No	I32	Actual position from 1st position sensor
COM_DP_PosVelocity	1277	-2147483648 – 2147483647	0	Yes	I32	Speed reference value (ramp mode), written by the Profibus
COM_DP_Acc	1278	0 – 0xFFFF	100	Yes	U16	Acceleration reference value (ramp mode), written by the Profibus
COM_DP_Dec	1279	0 – 0xFFFF	100	Yes	U16	Deceleration reference value (ramp mode), written by the Profibus
COM_DP_Controlword2	1280	0 – 0xFFFF	0	Yes	U16	2nd Control value, not used at first
COM_DP_Statusword2	1281	0 – 0xFFFF	0	No	U16	2nd status value, not used at first
COM_DP_Bus_Timeout	1283	0 – 4294967295	5000	Yes	U32	Bus timeout
COM_DP_Signal-List_write	1284	0 – 65535	0	No	U16	List of parameters that can be used as process data reference values
COM_DP_Signal-List_Read	1285	0 – 65535	0	No	U16	List of parameters that can be used as process data actual values
COM_DP_TMaxScale	1286	0 – 2000	1000	Yes	U16	Online torque scaling
COM_DP_TMaxPos	1287	0 – 2000	1000	Yes	U16	Positive online torque scaling
COM_DP_TMaxNeg	1288	0 – 2000	1000	Yes	U16	Negative online torque scaling

Parameter name	Number	Value range	Default value	Can be changed	Data type	Meaning
COM_DP_PZDSelection-Write	915	0 – 65535	967	Yes	U16	This parameter allows incoming process data to be linked to specific device parameters. The parameters that can be entered are listed in parameter 1284. The subindex 0 contains the first process data value PZD1 and so on.
COM_DP_PZDSelection-Read	916	0 – 65535	968	Yes	U16	This parameter allows outgoing process data to be linked to specific device parameters. The parameters that can be entered are listed in parameter 1285. The subindex 0 contains the first process data value PZD1 and so on.
COM_DP_Address	918	0 – 126	126	Yes	U16	Station address of the inverter
COM_DP_TelegramSelection	922	0 – 65535	0	Yes	U16	
COM_DP_SignalList	923	0 – 65535	0	No	U16	This parameter lists all “mappable” parameters and signals for parameters 915 and 916.
COM_DP_Warning	953	0 – 0xFFFF	0	No	U16	This parameter forwards warning messages from the Profibus. These include bus timeout and PLC stop mode.
COM_DP_Baudrate	963	9.6 – 45.45 kbits/s	9.6 kbit/s	No	U16	Current Baud rate for bus communication
COM_DP_DeviceId	964	0 – 65535	0	No	U16	This parameter is for device identification
COM_DP_ProfileNo	965	0 – 65535	0	No	U16	Profile number, not supported in the first step
COM_DP_Controlword	967	0 – 0xFFFF	0	Yes	U16	Control word for the internal status machine
COM_DP_Statusword	968	0 – 0xFFFF	0	No	U16	Status word for the internal status machine
COM_DP_DataStore	971	0 – 255	0	Yes	U16	This parameter permits storage of data in the non-volatile memory.
COM_DP_DefinedParameter	980	0 – 65535	0	No	U16	This parameter describes the defined parameters in the drive controller.
COM_DP_ModifiedParameter	990	0 – 65535	0	No	U16	This parameter describes all the parameters in the drive controller that are not set to the “default“ values.

Appendix Glossary

AK	Request identification
Application data set	Factory pre-defined data set for solution of typical applications
Diagnostic data	The master reads the diagnostic data from the slave and thus permits a central response to slave malfunctions.
DP	Distributed I/O
Master	The supervisory controller which provides communications.
MW	Flag word
Parameter data	The PKW parameter channel is used to transmit parameters cyclically to and from the drive device.
PKW	Parameter identification value
PNU	Parameter number
ProfiDrive Mode	Configuration of the process data channel, compatible with the ProfiDrive profile. In contrast to EasyDrive mode the system statuses are changed by defined series of control sequences. The system status machine defined in the PROFIBUS standard specifies the individual system status transitions.
PZD	Process data: The process data channel contains the functions “Load control and status”, “Input reference values” and “Display actual values”.
Slave	A slave is a bus participant on the PROFIBUS-DP, which in contrast to the master responds exclusively to the requests directed to it.
SPM	Spontaneous message
Status machine	This describes the transitions between the various systems statuses. A status transitions is triggered by a defined event such as a control sequence or the setting of an input.

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LUST

Lust Antriebstechnik GmbH
Gewerbestrasse 5-9 • 35633 Lahnau
Germany
Tel. +49 (0) 64 41 / 9 66-0
Fax +49 (0) 64 41 / 9 66-137
Internet: www.lust-tec.de
e-mail: info@lust-tec.de

Lust Antriebstechnik GmbH
Heinrich-Hertz-Str. 18 • 59423 Unna
Germany
Tel. +49 (0) 23 03/ 77 9-0
Fax +49 (0) 23 03/ 77 9-3 97
Internet: www.lust-tec.de
e-mail: info@lust-tec.de

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